

Having thus described the invention, it is so claimed:

1. A regenerable filter system comprising:

a flow path along which a stream of fluid flows between an inlet and an outlet;

a first filtering unit in said flow path between said inlet and said outlet, said first unit comprising first and second regenerable filter beds, each bed including a first adsorbent for removing
5 a first contaminant from said stream of fluid;

a first valve located between said inlet and said first and second filter beds for selectively directing said stream of fluid through one of said first and second filter beds, the other of said first and second filter beds being removed from said flow path;

a second filtering unit in said flow path between said first filtering unit and said
10 outlet, said second unit being located downstream from said first unit and including third and fourth regenerable filter beds, each bed including a second adsorbent for removing a second contaminant from said stream of fluid;

a second valve located between said first filtering unit and said third and fourth filter beds for selectively directing said stream of fluid through one of said third and fourth filter beds, the
15 other of said third and fourth filter beds being removed from said flow path; and,

a controller, said controller operating said first valve to direct said stream of fluid through a desired one of said first and second filter beds and operating said second valve to direct said stream of fluid through a desired one of said third and fourth filter beds, wherein said first and second filtering units are operated independent of one another.

2. The regenerable filter system of claim 1, further including a bypass loop for bypassing at least one of said first and second filter beds, said bypass loop including an upstream valve and a downstream valve for preventing fluid flow through said one filter bed.

3. The regenerable filter system of claim 2, wherein said bypass loop comprises a first bypass loop and said system further includes a second bypass loop for bypassing the other of said

first and second filter beds, said second bypass loop including an upstream valve and a downstream valve for preventing fluid flow through said other filter bed.

4. The regenerable filter system of claim 1, further including a first heat exchanger in said flow path between said first filter bed and said second valve, said first heat exchanger producing a regeneration heat necessary to regenerate said first filter bed.

5. The regenerable filter system of claim 4, further including a second heat exchanger in said flow path between said second filter bed and said second valve, said second heat exchanger producing a regeneration heat necessary to regenerate said second filter bed.

6. The regenerable filter system of claim 1, further including a third valve in said flow path between said second filtering unit and said outlet, said third valve selectively directing said stream of fluid from said one of said third and fourth filter beds to said outlet.

7. The regenerable filter system of claim 6, further including a third heat exchanger also in said flow path and between said third filter bed and said third valve, said third heat exchanger producing a regeneration heat necessary to regenerate said third filter bed.

8. The regenerable filter system of claim 7, further including a fourth heat exchanger in said flow path between said fourth filter bed and said third valve, said fourth heat exchanger producing a regeneration heat necessary to regenerate said fourth filter bed.

9. The regenerable filter system of claim 1, wherein said controller controls first and second regeneration cycles for said first and second filtering units.

10. The regenerable filter system of claim 9, wherein said first and second regeneration cycles are unequal in duration.

11. The regenerable filter system of claim 1, wherein said stream of fluid includes moisture and said system further including a device in said flow path between said inlet and said first filtering unit for removing a portion of said moisture from said stream of fluid.

12. The regenerable filter system of claim 11, wherein said device comprises an inline cooler in said flow path.

13. The regenerable filter system of claim 1, further including an air pressuring member upstream from said first valve.

14. The regenerable filter system of claim 1, wherein said first and second filter beds each house a set amount of said first adsorbent and said third and fourth filter beds each house a set amount of said second adsorbent, said set amount of said first adsorbent being unequal to said set amount of said second adsorbent.

15. The regenerable filter system of claim 1, wherein said first and second filter beds each have a filter housing with a first length and said third and fourth filter beds each have a filter housing with a second length, said first length and said second length being unequal.

16. The regenerable filter system of claim 1, further including an inline temperature controller in said flow path for maintaining said stream of fluid at a specified temperature as it enters said first filtering unit.

17. The regenerable filter system of claim 1, wherein said first and second adsorbents comprise temperature swing adsorbents, said first and second filter beds being regenerated at a first regeneration temperature, said third and fourth filter beds being regenerated at a second regeneration temperature.

18. The regenerable filter system of claim 1, further including a first temperature sensor in said first filter bed and a second temperature sensor in said second filter bed, said first and second temperature sensors being in communication with said controller and one of said first and second sensors governing a regeneration cycle of said first filter unit.

19. The regenerable filter system of claim 1, further including a third temperature sensor in said third filter bed and a fourth temperature sensor in said fourth filter bed, said third and fourth temperature sensors being in communication with said controller and one of said third and fourth sensors governing a regeneration cycle of said second filter unit.

20. The regenerable filter system of claim 1, wherein said first and second adsorbents comprise a material selected from silica gels, alumina silicates, activated carbons, polymeric resins and combinations thereof.

21. The regenerable filter system of claim 1, wherein at least one of said first and second adsorbents includes more than one adsorbent material.

22. A method of removing at least a first and a second contaminant from a stream of fluid, said method including the steps of:

providing said stream of fluid;

directing said stream of fluid through a filtering system having a first filtering unit with first and second regenerable filter beds and a second filtering unit with third and fourth regenerable filters beds, said first and second filtering units being in fluid connection with one another;

filtering a first contaminant from said stream of fluid in said first filtering unit;

filtering a second contaminant from said stream of fluid in said second filtering unit;

regenerating one of said first and second filter beds of said first filtering unit; and,

regenerating one of said third and fourth filter beds of said second filtering unit independent of said step of regenerating said one of said first and second filter beds.

23. The method of claim 22, further including the step of changing the temperature of said stream of fluid.

24. The method of claim 23, further including the step of cooling said stream of fluid.

25. The method of claim 23, further including the step of heating said stream of fluid.

26. The method of claim 23, further including the step of cooling said stream of fluid and then heating said stream of fluid.

27. The method of claim 22, further including the step of regulating a duration of said step of regenerating said one of said first and second filter beds of said first filtering unit by sensing temperature in said first and second filter beds.

28. The method of claim 22, further including the step of regulating a duration of said step of regenerating said one of said third and fourth filter beds of said second filtering unit by sensing temperature in said third and fourth filter beds.

29. The method of claim 22, wherein said regenerating said one first and second filter beds is for a first regeneration cycle and said regenerating said one third and fourth filter beds is for a second regeneration cycle, said first and second regeneration cycles being unequal in duration.

30. The method of claim 22, wherein said regenerating said one first and second filter beds is for a first regeneration cycle and said regenerating said one third and fourth filter beds is for a second regeneration cycle, said method further including the step of controlling said first and

5 second regeneration cycles based on at least one physical characteristic of the respective first and second filter beds.

31. The method of claim 22, further including the step of changing the humidity of said stream of fluid.

32. The method of claim 22, wherein one of said first and second contaminants is a high boiling vapor chemical.

33. The method of claim 32, wherein the other of said first and second contaminants is a low boiling vapor chemical.

34. The method of claim 22, wherein said regenerating said one first and second filter beds comprises the steps heating a purge fluid, passing the purge fluid through one of said first and second filters beds, heating said one of said first and second filter beds and extracting a chemical from the fluid.

35. The method of claim 34, further including the step of sensing temperature in said one first and second filter beds.

36. The method of claim 35, further including the step of cooling said one first and second filter beds when temperature sensed reaches a set point.

37. The method of claim 22, wherein said step of regenerating said one of said first and second filter beds is for a first regeneration cycle and said step of regenerating said one of said third and fourth filter beds is for a second regeneration cycle, said first regenerating cycle being about 60-180 minutes.

38. The method of claim 37, wherein said first regenerating cycle is about 2 hours.
39. The method of claim 37, wherein said second regenerating cycle is about 10-90 minutes.
40. The method of claim 39, wherein said second regenerating cycle is about 20 minutes.
41. The method of claim 22, wherein said regenerating comprises the steps of heating a filter bed at a first end thereof, sensing temperature of said filter bed between said first end and a second end, begin cooling said filter at said first end before said second end is heated to a predetermined temperature.
42. The method of claim 22, further including the step of maintaining said stream of fluid at a relative humidity of between 30% to 45% before said step of directing said stream of fluid.
43. The method of claim 22, wherein said step of regenerating said one of said third and fourth filter beds of said second filtering unit comprises the steps heating a purge fluid, passing the purge fluid through one of said third and fourth filters beds, heating said one of said third and fourth filter beds and extracting a chemical from the one of said third and fourth filter beds.
44. The method of claim 43, wherein said first filtering unit includes a bypass loop and said regenerating said one of said third and fourth filter beds of said second filtering unit includes the step of bypassing said first filtering unit.
45. A regenerable filter system comprising:
a first flow path along which a stream of process fluid flows between a process fluid inlet and a process fluid outlet;

a first filter unit in said first flow path, said first filter unit comprising a first
5 regenerable filter bed having a first adsorbent for removing a first contaminant from said stream of
fluid;

a second filter unit in said first flow path, said second unit being located between said
first unit and said outlet of said first flow path, said second unit comprising a second regenerable
filter bed having a second adsorbent for removing a second contaminant from said stream of fluid;

10 a second flow path along which a stream of regeneration fluid flows between a
regeneration fluid inlet and a regeneration fluid outlet;

a controller for selectively directing said process fluid through said first flow path and
said regeneration fluid through said second flow path, wherein a regeneration cycle of said first filter
unit is independent of a regeneration cycle of said second filter unit.

46. The regenerable filter system of claim 45, wherein regeneration is thermal
regeneration and regeneration temperatures of said first and second filter units are different.

47. The regenerable filter system of claim 45, wherein said regeneration cycles of said
first and second filter units are of different durations.

48. The regenerable filter system of claim 47, wherein intervals between said regeneration
cycles of said first and second filter units are different.

49. The regenerable filter system of claim 45, further comprising a first valve located
between said process fluid inlet and said first filter unit in said first flow path and between said
regeneration fluid outlet and said first filter unit in said second flow path, and a second valve located
between said first filter unit and said second filter unit, said first and second valves directing said
5 flow of said process fluid and said regeneration fluid.

50. The regenerable filter system of claim 49, further comprising a third valve located between said regeneration fluid inlet and said second filter unit in said second flow path and between said process fluid outlet and said second filter unit in said first flow path, said third valve further directing said flow of said process fluid and said regeneration fluid.

51. The regenerable filter system of claim 45, further comprising a temperature control system for maintaining a desired temperature of said process fluid.

52. The regenerable filter system of claim 45, further comprising a humidity control system for regulating a humidity of said process fluid.

53. The regenerable filter system of claim 45, further comprising a first heater for heating said regeneration fluid to a desired regeneration temperature, wherein regeneration is a thermal regeneration.

54. The regenerable filter system of claim 53, further comprising a second heater for heating said regeneration fluid to a desired temperature, wherein said first heater is located adjacent said first filter unit and said second heater is located adjacent said second filter unit.

55. The regenerable filter system of claim 53, wherein said first heater comprises a heat exchanger.

56. The regenerable filter system of claim 45, further comprising a pressurization system for said process fluid.